

Arthroscopic Management for Bipartite Patella

A Systematic Review

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Background: Bipartite patella is a rare congenital condition that becomes painful following direct trauma or an overuse injury. If it remains painful despite nonoperative treatment, surgery may be warranted. The current gold standard is open fragment excision or lateral release; however, arthroscopic management is also possible.

Purpose: To investigate the safety and efficacy of arthroscopic treatment of painful bipartite patella.

Study Design: Systematic review; Level of evidence, 4.

Methods: Using Medline and Embase, we systematically reviewed the literature as of March 8, 2020, using the subject headings “bipartite patella” and “arthroscopy” and related key terms. All levels of evidence involving human studies in English were included. Articles were excluded if only the abstract was published or the study was related to nonsurgical treatment or nonrelated diagnoses. Data related to journal/article information, demographic/clinical data, arthroscopic technique, length of follow-up, treatment outcomes, and complications were extracted.

Results: Eleven articles with 43 patients were included in the review. Most patients (n = 34; 79%) underwent arthroscopic lateral release, while 16% (n = 7) had arthroscopic excision of the accessory fragment and 5% (n = 2) had arthroscopic excision and release. All patients except for one, who experienced postoperative trauma, were pain-free after arthroscopic treatment and were able to return to sports after a mean 2.6 months.

Conclusion: This review demonstrated that arthroscopic management of painful bipartite patella is a safe and effective alternative to open surgical excision or release. However, all articles were case studies or small case series, owing to the rarity of the condition. In the future, higher-level studies comparing arthroscopic techniques and postoperative rehabilitation programs should be performed.

Keywords: bipartite patella; patella; arthroscopy; minimally invasive; lateral release; fragment excision

The patella is part of the anterior knee joint and acts as a bony attachment point for the quadriceps and patellar tendons. Bipartite patella is a congenital condition resulting

from abnormalities in the ossification process of the patella.¹⁶ This process begins between 3 and 5 years of age, starting at multiple foci that eventually merge. In bipartite patella, there is failure of these ossification centers to fuse, resulting in an accessory fragment connected by a fibrocartilaginous zone.²¹ The most commonly used classification of bipartite patella, developed by Saupe,²⁵ classifies the lesion based on location of the accessory fragment: type 1 (5%), at the inferior patellar pole; type 2 (20%), at the lateral margin of the patella; and type 3 (75%), at the superolateral pole.

This condition is often asymptomatic and found incidentally on knee radiographs. The incidence of bipartite patella in the adult population is between 0.6% and 2%^{10,14} with approximately half occurring bilaterally¹⁰ and the majority occurring in male patients, where it is up to 9 times more common than in female patients.^{2,16,24} However, 2% of these patients have painful bipartite patella.²³ Symptoms can occur after direct trauma or overuse injury causing

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disruption to the fibrocartilaginous zone between the primary and accessory patellar fragments. This can result in abnormal motion, friction, and edema.¹⁴ These patients typically present with anterior knee pain localized around the accessory fragment and exacerbated by extension of the knee.³

Initial treatment of painful bipartite patella is conservative and includes physical activity modifications, immobilization, nonsteroidal anti-inflammatory drugs, physical therapy,^{3,9,22,26,29} and local corticosteroid injections.¹⁷ Within 2 to 6 months, nonoperative treatment is successful in the majority of cases³; however, if pain persists, surgical treatment should be considered. Surgical options can be arthroscopic or open and include

- Excision of the accessory fragment^{5,12}
- Lateral retinacular release (LRR) to decrease traction laterally and proximally on the patella, thus promoting bony union and reducing pain,²⁰ or vastus lateralis release (VLR) solely at the attachment of the tendon to the fragment, thus decreasing traction forces on the patella¹
- Open reduction and internal fixation (ORIF) of the accessory fragment^{3,9}

In this study, we aimed to systematically review the literature with regard to the use of arthroscopy in the management of painful bipartite patella. We hypothesized that pain relief and full return to prior physical activity can be achieved with less invasive treatment options for symptomatic bipartite patella. We also hypothesized that the complication rate of arthroscopic treatment of bipartite patella would be low.

METHODS

One reviewer (A.L.) searched Medline and Embase for articles related to the arthroscopic treatment of bipartite patella published on or before March 8, 2020, using the following subject headings and their related key terms: “bipartite patella” and “arthroscopy.” Figure 1 outlines the search strategy used.

Inclusion criteria consisted of all levels of evidence, male and female patients, patients of all ages, human studies, English language of publication, and arthroscopic treatment. Exclusion criteria included studies published in abstract form only, any nonsurgical treatment studies (eg, cadaveric studies, conservative treatment, review articles), and patients with nonrelated diagnoses. The reviewer screened the titles and abstracts of the studies to identify articles for full-text review. An article was included after passing a full-text review by 2 reviewers (A.L., S.M.G.). Duplicates in the second database search were excluded.

Relevant data from the articles were then added to a spreadsheet using Excel Version 16.35 (Microsoft). This included journal/article information (ie, author, year of publication, sample size, study design), demographic/clinical data (ie, age, sex, affected side), arthroscopic technique used (ie, arthroscopic portals, instruments used), length of follow-up, treatment outcomes, and complications. The

<u>Medline, March 8, 2020</u>	
1) Bipartite.tw,kf.	5270
2) Patella/ab [Abnormalities]	408
3) Knee joint/ab [Abnormalities]	496
4) Arthroscopy/ or arthroscop*.mp.	35,534
5) Arthroscopy/mt [Methods]	8382
6) Minimally invasive surgical procedure/mt [Methods]	12,680
7) 1 or 2 or 3	6102
8) 4 or 5 or 6	47,969
9) 7 and 8	95

95 articles total
86 English language, 9 foreign language excluded

Total to review: 86

<u>Embase, March 8, 2020</u>	
1) Arthroscop*.mp.	47,385
2) Arthroscopy/ or knee arthroscopy/	25,514
3) Minimally invasive surgery/	40,858
4) Bipartite.mp.	5335
5) Patella/su [Surgery]	796
6) 1 or 2 or 3	87,500
7) 4 or 5	6124
8) 6 and 7	134

134 articles total
109 English language, 25 foreign language excluded

Total to review: 109

Figure 1. Search strategy.

primary outcome for this review is symptom relief after arthroscopic treatment. Secondary outcomes include return to sport, functional scores, and complications. Owing to the heterogeneity of the studies, only a qualitative assessment was performed, and meta-analysis was not possible.

RESULTS

The database search resulted in 163 articles once duplicates had been removed. Of these, 130 articles were removed after title review, 19 after abstract review, and 3 after full-text review, resulting in 11 articles[‡] (43 patients) being included (Figure 2). All articles were case reports or case series. Details are available in Appendix Tables A1 and A2.

Of the 43 cases, 40 (93%) were male. The mean age of the patients was 18.6 years (range, 10-37 years). Patients were generally healthy; however, 1 patient (2.3%) had nail-patella syndrome, 1 (2.3%) had snapping knee syndrome, and 1 (2.3%) had a radial lateral meniscal lesion that was repaired intraoperatively. The affected side was equally distributed where reported, with 21 (48.8%) cases involving the right side and 21 (48.8%) involving the left side.

[‡]References 1, 4, 6-8, 12, 13, 15, 27, 28, 30.

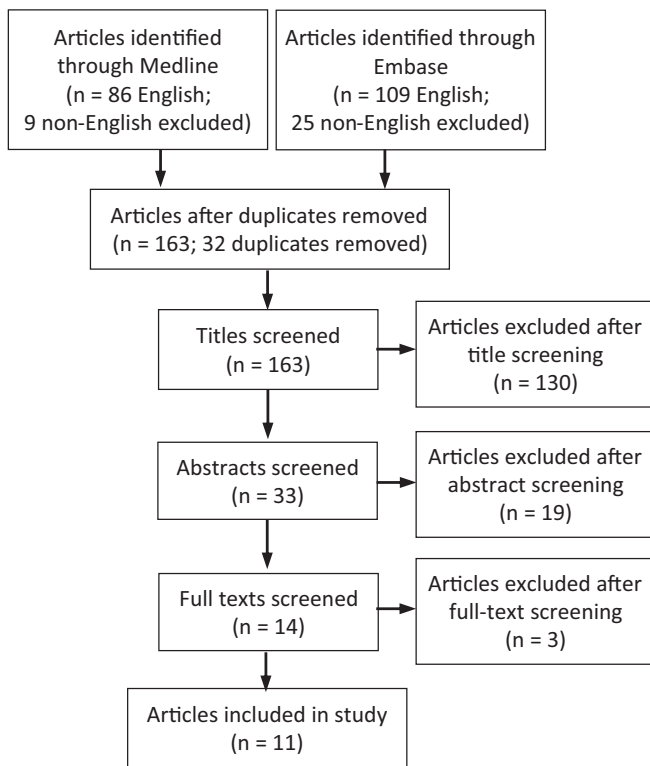


Figure 2. Flowchart of article inclusion.

Following the Saupe classification, 1 case (2.3%) was type 1; 2 cases (4.7%) were type 2; and 39 cases (91.0%) were type 3. Kumar et al¹⁵ reported that their case (2.3%) did not fit into the Saupe classification, as the patella appeared to have 2 primary ossification centers. Only 3 cases (7%) had a history of trauma to the knee before the pain started: the patients of Carney et al⁶ and Yoo et al³⁰ had blunt trauma to the anterior knee, and the patient of Azarbod et al⁴ jumped from a height of 2 m. All patients received a minimum 3 months of nonoperative treatment, such as nonsteroidal anti-inflammatory drugs and physical therapy, before attempting arthroscopic treatment.

In terms of surgical technique, 7 articles involving 37 patients (86%) reported the location of arthroscopic portals used. Twenty-five cases (68%) used the conventional lateral and medial anterior or infrapatellar portals. Three of those cases required an additional superolateral or superomedial portal. Azarbod et al⁴ used an anterolateral portal with superomedial and superolateral portals, while Felli et al⁸ used an anteromedial portal and superolateral portal. The instruments used to excise the accessory fragment and/or release the vastus lateralis or lateral retinaculum were reported in 9 articles (39 patients; 90.7%). Seven cases (16%) required excision of the fragment; 2 cases (5%) had excision and release; and 34 cases (79%) underwent arthroscopic release—11 (25.6%) of which were LRR, 22 (51.2%) VLR, and 1 (2.3%) an unspecified type of lateral release.

A postoperative rehabilitation protocol was reported in 8 of the 11 studies (40 patients; 93.0%). Of these, the rehabilitation varied. Three studies (25 patients; 58.1%)

indicated the use of knee immobilization braces for a mean 4.3 days (range, 2 days–3 weeks), while 5 studies (15 patients; 34.9%) cited immediate postoperative full weight-bearing and activity as tolerated. The rehabilitation programs also allowed for return to sport at a mean 8.3 weeks (range, 6–8.5 weeks).

Length of follow-up was between 25 days and 31 months with a mean 6.8 months and a median 6.3 months. Primary outcomes of pain relief were measured using various scales: Ogata criteria, Lysholm score, patient satisfaction, or simply presence of pain versus no pain. Regardless of scale, all patients except 1 (42 of 43; 97.7%) were pain-free at final follow-up. One patient (2.3%) in the Kumar et al¹⁵ study experienced the only postoperative complication in this review. At 3 weeks after arthroscopic lateral release with medial plication, the patient twisted his knee causing separation of the bipartite fragments requiring ORIF. This patient was also known for nail-patella syndrome. Therefore, the success rate of painful bipartite patella treated with arthroscopic management was 97.7% (42 of 43). The mean duration for return to full level of sports activity was 2.6 months (range, 30 days–1 year).

Seven articles (27 patients; 62.8%) examined radiological outcomes, either to confirm excision of the accessory fragment or to determine whether bone union after LRR or VLR decreased tension between the fragments. Of the 23 patients (53.5%) who were examined for bone union, 16 (70%) had complete bone union at a mean 6.8 months (range, 4–12 months) of postoperative follow-up—although it should be noted that 1 of these patients had undergone ORIF after a postoperative trauma and 7 (30%) had incomplete bone union at a mean 4.4 months (range, 1.5–6 months) of postoperative follow-up.

For soft tissue procedures, VLR and LRR had good postoperative outcomes, although they are difficult to compare statistically, as studies used various measurements of improvement. Of the 22 patients who underwent VLR, 18 (82%) had excellent primary outcomes and 4 (18%) had good outcomes. All 22 patients returned to sport at a mean 3 months postoperatively, and 15 (68%) had complete bone union at a mean 7 months of follow-up. Conversely, of the 11 patients who underwent LRR, there were significant improvements in all patients' Kujala and visual analog scale scores postoperatively, and all patients returned to sport by a mean 42.3 days.

DISCUSSION

Bipartite patella is a relatively uncommon and often asymptomatic pathology. When nonoperative treatment fails, surgery is the next option. This review demonstrated favorable outcomes after arthroscopic management of symptomatic bipartite patella, showing pain relief in >95% of the patients, <3 months' duration to return to full level of activity, and a complication rate <5%.

Of the patients in this review, the majority (93%) were male. This is representative of the population that has bipartite patella. As previously stated, the condition is up to 9 times more common in male than female patients.^{2,16,24}

Moreover, given the young mean age of symptom onset in these otherwise healthy and typically active patients and the minimal number (just 7%) reporting a history of trauma to the knee, it appears that symptoms of bipartite patella are more commonly secondary to overuse injury as opposed to direct trauma. The review also found that arthroscopic management was successful in relieving pain in 42 of the 43 patients (97.7%), with the only patient who had recurrence of pain experiencing trauma to the knee postoperatively.

Traditional surgical techniques include open excision, open LRR, and ORIF. Matic and Flanigan¹⁸ reviewed the efficacy of these techniques. They examined 85 patients who underwent open excision of the accessory fragment, which resulted in 98% of patients returning to preoperative activity levels and 85% having complete pain relief postoperatively.

Soft tissue procedures such as VLR and LRR have been reviewed. VLR is thought to have better results, as it minimizes potential abnormal patellofemoral tracking postoperatively¹ and reduces potential loss of quadriceps strength¹¹ as compared with LRR. Matic and Flanigan¹⁸ reviewed studies totaling 33 patients and found no statistical difference between open and arthroscopic releases at 1 year of follow-up. However, the arthroscopic group had a shorter duration of postoperative knee effusion and was able to regain muscle strength more quickly. All of the patients, whether in the open or arthroscopic group, were able to return to their previous levels of sports activity; however, 31% of those who underwent LRR continued to have occasional pain.

McMahon et al¹⁹ reviewed 4 cases of ORIF, 3 of which involved tension band wiring. One patient returned to sports within 3 months; 1 was pain-free at 6 weeks; and the other 2 required subsequent surgery to remove the hardware after fracture healing owing to ongoing knee tenderness. These patients also required longer immobilization before starting postoperative rehabilitation. Therefore, this study demonstrates nonsuperiority of open surgical management of bipartite patella as compared with arthroscopic management.

Arthroscopy is minimally invasive and thus offers potential for decreased length of hospital stay, recovery time,¹ and risk of complications, such as postoperative malalignment of the patellofemoral joint.

There are several limitations to this review. The only articles found were case reports and case series, making it difficult to compare arthroscopic with other treatment options. This is likely due to the low prevalence of bipartite patella in the population and that arthroscopic treatment requires a high level of surgical skills as compared with an open approach. Moreover, there was heterogeneity among data in the various studies. Techniques for arthroscopic excision or release were inconsistent among studies; different portals and instruments were used for different cases. There was also no consensus among postoperative rehabilitation and follow-up protocols. This made it difficult to determine exact timelines for resolution of symptoms or return to sport. Some based it on the last follow-up appointment, while others reported the specific number of days before return to sport for each patient. Additionally,

comparing primary outcomes of pain relief was challenging given the variation in reporting; specifically, some methods were objective whereas others indicated only if the patient was pain- or symptom-free but did not quantify such status with validated tools. Additionally, since the indications and contraindications for arthroscopic interventions were not clearly defined in the available literature, there might have been a selection bias toward patients with particular characteristics for arthroscopic treatment, which could have resulted in favorable outcomes.

Overall, this review demonstrates that arthroscopic treatment is safe and effective for the management of painful bipartite patella and can be considered an alternative option to an open approach. Nevertheless, clear indications and contraindications for this surgical intervention should be studied and established. Future research should aim to determine a specific and most efficient arthroscopic surgical technique and postoperative rehabilitation program to optimize timelines of pain relief and return to sport. Further studies comparing open and arthroscopic techniques and detailed indications for the type of arthroscopic technique should be encouraged.

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APPENDIX

TABLE A1
Demographics, Surgical Techniques, and Postoperative Protocols of Studies Reviewed on Arthroscopic Treatment of Painful Bipartite Patella^a

Lead Author (Year)	Sample Size	Sex, M/F	Mean Age, y	Side, R/L	Saupe Type	History of Trauma	Time of Nonoperative Treatment	Portals	Technique	Postoperative Complications	Postoperative Rehabilitation
Adachi (2002) ¹	10/17	10/0	13.8	5/5	3	No	Minimum 3 mo	Lateral + medial infrapatellar	VLR	None	Knee immobilized at 20° × 2 d. Active quad exercises postoperative. WBAT at 1 wk. Running at 3-4 wk. RTS at 2 mo
Azarbod (2005) ⁴	1	1/0	26	1/0	3	Yes, jump from 2 m	9 mo	Anterolateral + superolateral + superomedial	Excision	None	NR
Carney (2010) ⁶	1	1/0	19	0/1	3	Yes, knee struck another player's knee	2 y	Anterolateral + anteromedial + superolateral	VLR then excision	None	ROM as tolerated, RTS at 6 wk
Felli (2011) ⁷	1	0/1	22	NR	2	No	3 mo	NR	Excision + lateral release	None	NR
Felli (2018) ⁸	11	11/0	22.1	6/5	3	NR	Minimum 3 mo	Anteromedial + superolateral	Lateral retinacular release	None	Quad isometric exercises + passive ROM 2/d. Massages + patellar manipulation. WBAT with crutches × 1 wk. Running and beginner sports-specific activity allowed at 3 wk
Ishikawa (2016) ¹²	12	10/2	15.7	7/5	3	No	Minimum 3 mo	Lateral + medial infrapatellar	VLR	None	Knee immobilized at 20° × 2 d then passive ROM. WBAT × 1 wk. Running and jumping at 3-4 wk. RTS at 2 mo
James (2017) ¹³	1	1/0	16	0/1	3	No	2 y	Medial + lateral parapatellar + accessory superolateral	Excision	None	WBAT. ROM + stationary bike on postoperative day 1. Quad strengthening. RTS at 6 wk

(continued)

TABLE A1 (continued)

Lead Author (Year)	Sample Size	Sex, M/F	Mean Age, y	Side, R/L	Saupe Type	History of Trauma	Time of Nonoperative Treatment	Portals	Technique	Postoperative Complications	Postoperative Rehabilitation
Kumar (1999) ¹⁵	1	1/0	36	0/1	NR	No	15 mo	NR	Lateral release + medial plication	3 wk: twisted knee causing separation of bipartite fragment requiring ORIF	Active and passive ROM
Vaishya (2015) ²⁷	3/5	3/0	19.7	1/2	3	No	6 mo	NR	Excision	None	Knee immobilized with splint for 3 wk. Knee flexion, quad exercises, and WBAT with crutches
Werner (2013) ²⁸	1/3	1/0	16	0/1	1	No	4 mo	Anterolateral + anteromedial	Excision	NR	Postoperative WBAT with crutches. Active and passive open chain rehabilitation. No running or jumping × 6 wk
Yoo (2008) ³⁰	1	1/0	37	1/0	2	Yes, knee collided with desk 2 mo prior	NR	Anterolateral or superomedial + anteromedial	Excision	None	NR

^aF, female; L, left; M, male; NR, not reported; ORIF, open reduction and internal fixation; R, right; ROM, range of motion; RTS, return to sport; VLR, vastus lateralis release; WBAT, weightbearing as tolerated.

TABLE A2
Postoperative Outcomes of Studies Reviewed on Arthroscopic Treatment of Painful Bipartite Patella^a

Study	Follow-up	Primary Outcome	Secondary Outcome	Radiological Outcome	Remarks
Adachi (2002) ¹	12 mo	Ogata criteria: 8 pts excellent, 2 pts good	<ul style="list-style-type: none"> · RTS, 3.0 ± 0.9 mo (vs 3.4 ± 1.1 mo for open) · Circumference of thigh: significantly lower in arthroscopy group · Peak torque extension of knee: return to preoperative level at 6 mo postoperative (vs 9 mo for open) · Peak torque angle: no significant difference 	6 mo postoperative: 7 pts complete bone union, 3 pts incomplete bone union	Note: the other 7 pts were treated with open VLR
Azarbod (2005) ⁴	1.5 mo	Full recovery, pain-free	NR	NR	
Carney (2010) ⁶	6 mo	Complete resolution of symptoms + return to presymptom level of strength and play	RTS 6 wk	Confirmed successful excision	
Felli (2011) ⁷	12 mo	Symptom-free, full athletic recovery	RTS < 1 y	Confirmed fragment removed	Note: pt also had radial lesion (0.8 cm) of lateral meniscus, which was also repaired
Felli (2018) ⁸	69.6 ± 33.3 d	Pre- vs postoperative: <ul style="list-style-type: none"> · Kujala, 56.8 ± 8.7 vs 96.4 ± 7.2 · TAS, no difference · VAS, 6.7 ± 0.8 vs 0.9 ± 1.3 	RTS, 42.3 ± 11.3 d	NR	

(continued)

TABLE A2 (continued)

Study	Follow-up	Primary Outcome	Secondary Outcome	Radiological Outcome	Remarks
Ishikawa (2016) ¹²	6.3 ± 2.7 mo	Ogata criteria: 10 pts excellent, 2 pts good	RTS, all <3 mo	8 pts bone union, 4 pts no bony union	
James (2017) ¹³	31 mo	Patient satisfaction 10/10	Lysholm score, 71-100; IKDC score, 65.5-72.4; RTS at 6 wk	Complete removal of fragment	
Kumar (1999) ¹⁵	4 mo	NR	NR	Bone union after ORIF	Note: pt also had nail-patella syndrome
Vaishya (2015) ²⁷	3 mo	Pain-free	NR	NR	Note: the other 2 pts had larger type 3 and were removed via ORIF
Werner (2013) ²⁸	3 mo	Pain-free	RTS: <3 mo	Absence of fragment	Note: preoperative MRI performed to assess relation of fragment to extensor mechanism
Yoo (2008) ³⁰	NR	Full return to ADL	NR	NR	Note: pt also had snapping knee syndrome

^aValues are presented as mean ± SD where indicated. ADL, activities of daily living; IKDC, International Knee Documentation Committee; MRI, magnetic resonance imaging; NR, not reported; ORIF, open reduction and internal fixation; pt, patient; RTS, return to sport; TAS, Tegner Activity Scale; VAS, visual analog scale; VLR, vastus lateralis release.